



**Arizona  
Department of Transportation**

**WORKBOOK**

for

**INCIDENTALS  
INSPECTION  
(Course Number 105)**

a training course developed  
for the

**ARIZONA DEPARTMENT OF TRANSPORTATION**  
Phoenix, Arizona

by

**ROY JORGENSEN ASSOCIATES, INC.**  
Gaithersburg, Maryland

Revised by ADOT – July 1. 2002

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# Table of Contents

<b>Directions To Workbook Users .....</b>	<b>1</b>
<b>Section One: Fences .....</b>	<b>4</b>
Setting Fence Posts .....	6
Installing Chain-Link Fences and Gates .....	7
Installing Wire Fences and Gates .....	8
Installing Cattle Guards .....	9
Section One Quiz .....	10
Section One Quiz Answers .....	12
<b>Section Two: Guardrails .....</b>	<b>13</b>
Guardrail Materials .....	13
Setting Guardrail Posts .....	13
Installing Guardrail Elements .....	14
Elements.....	14
Section Two Quiz .....	16
Section Two Quiz Answers .....	17
<b>Section Three: Bank Protection.....</b>	<b>18</b>
Types.....	18
General Construction Requirements .....	19
Dumped Riprap .....	19
Wire-Tied Riprap .....	19
Grouted Riprap.....	19
Slope Mattress Riprap.....	20
Gabions .....	20
Sacked Concrete Riprap.....	20
Rail Bank Protection .....	21
Section Three Quiz .....	22
Section Three Quiz Answers .....	24
<b>Section Four: Landscaping .....</b>	<b>25</b>
Preparations for Landscaping .....	25
Landscaping Excavation and Grading .....	25
Landscape Borrow .....	25
Topsoil .....	26

Irrigation Systems .....	26
Seeding.....	26
Trees Plants and Shrubs .....	27
Preparations for Planting.....	27
Planting .....	28
Pruning and Staking.....	28
Care and Protection.....	29
Section Four Quiz .....	30
Section Four Quiz Answers .....	31

# Directions To Workbook Users

**Incidentals Inspection** (Course Number 105) is one in a series of training courses on inspection and quality control for earthwork construction. Other courses in the series include:

- Field Sampling and Testing for Earthwork (Course 101),
- Excavation and Embankment Inspection (Course 102),
- Pipe Placement Inspection (Course 103), and
- Subgrade and Base Course Inspection (Course 104).

This course is designed primarily for highway construction inspection personnel, but it can also be used in training other personnel.

This Workbook is to be used in conjunction with discussion sessions with the trainee's instructor or supervisor, and other materials that make up the course. As sections of this Workbook are assigned, each trainee should.

1. read and study the material to review previously presented information and gain additional details,
2. complete the exercises and quizzes as they are provided,
3. check his answers against those provided following the exercise or quiz,
4. review the material as needed to correct and clarify any incorrect answers, and
5. discuss any areas that are still not clearly understood with his instructor or supervisor.

Each trainee should be provided with his own copy of this Workbook so that he can write in it and keep it for future reference and review.

This course is based primarily on the following sections of the ADOT's *Standard Specifications for Road and Bridge Construction*:

801 – Landscape Excavation,  
802 – Landscape Grading,  
803 – Landscape Plating Materials,  
804 – Topsoil,  
805 – Seeding,  
806 – Trees, Shrubs and Plants,  
807 – Landscaping Establishment,  
808 – Water Distribution,

902 – Chain Link Fence,  
903 – Wire Fence,  
904 – Chain Link Cable Barrier,  
905 – Guardrail,  
906 – Cattle Guards,  
913 – Bank Protection, and  
1012 – Guardrail Materials.

The following sections of the ADOT's *Construction Manual* Also provided information for this course:

801 – Landscape Excavation,  
802 – Landscape Grading,  
803 – Landscape Borrow,  
804 – Topsoil,  
805 – Seeding,  
806 – Trees, Shrubs and Plants,  
807 – Landscape Establishment,

808 – Landscape Irrigation Systems,  
902 – Chain Link Fence,  
903 – Wire Fence,  
904 – Chain Link Cable Barrier,  
905 – Guardrail,  
906 – Cattle Guards  
913 – Bank Protection, and  
1012 – Guardrail Materials.

# **Notes**

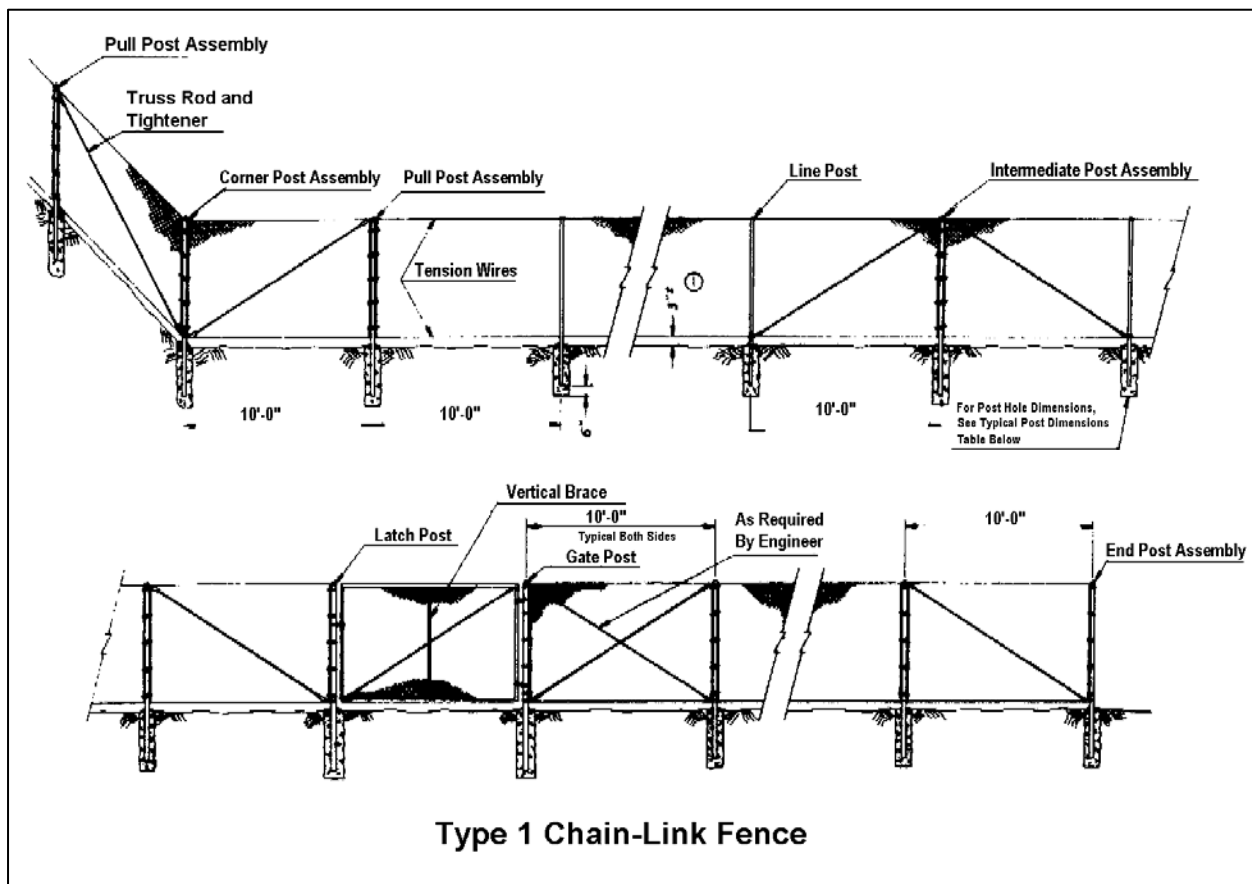
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## Section One: Fences

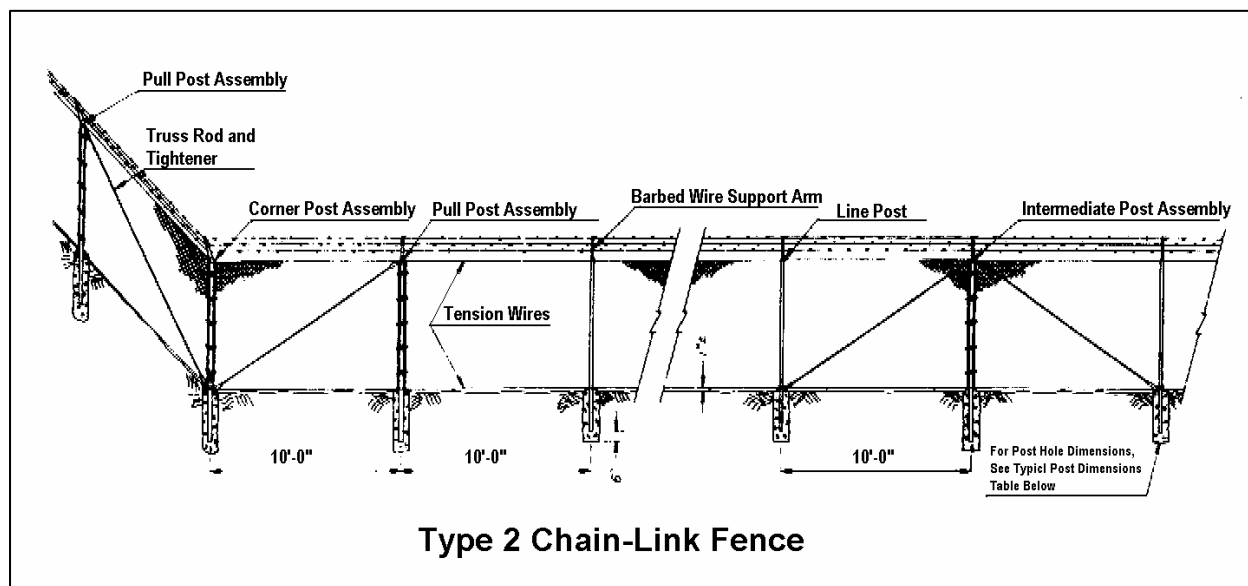
For highway construction, we are concerned with four basic types of fence:

- Chain-link Fence,
- Chain-Link Cable Barrier,
- Wire Fence, and
- Cattle Guards.

There are two types of chain-link fence, Type 1 and Type 2. The most obvious difference between them is that Type 2 has strands of barbed wire stretched above the chain-link fabric. The fabric, steel posts, hardware and fittings used to construct a chain-link fence can be made of zinc-coated steel or aluminum-coated steel. On any given project, the items needed to build a chain-link fence must all be zinc-coated or aluminum-coated steel. These two different types of coated steel products cannot be used interchangeably on a given project.

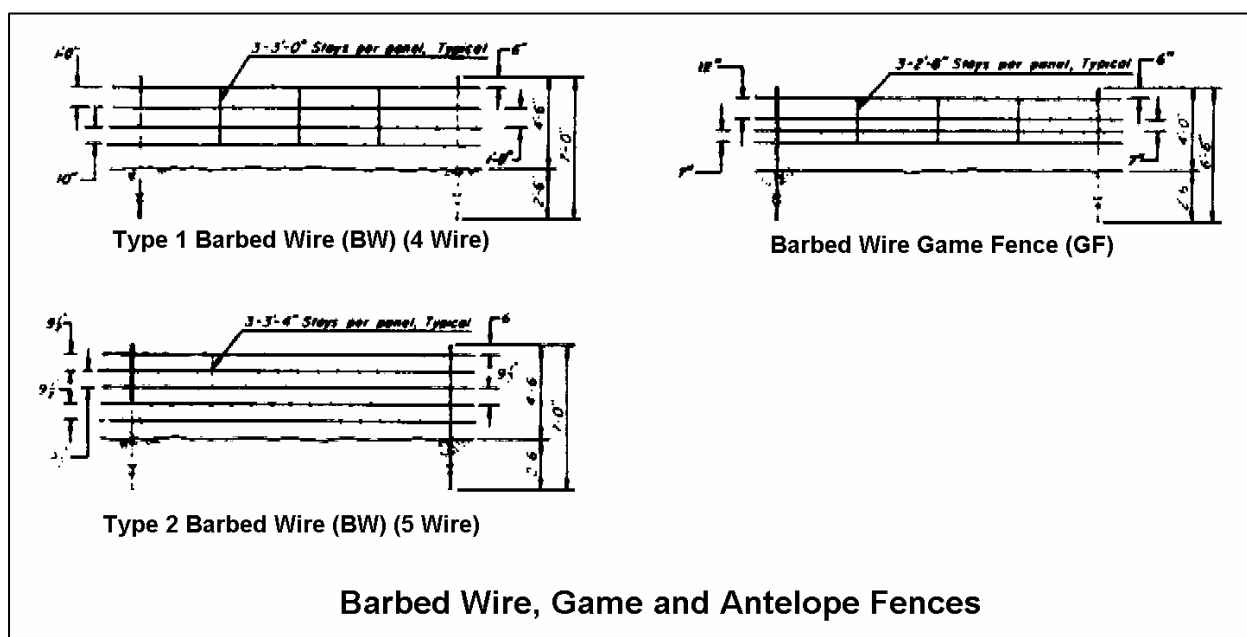




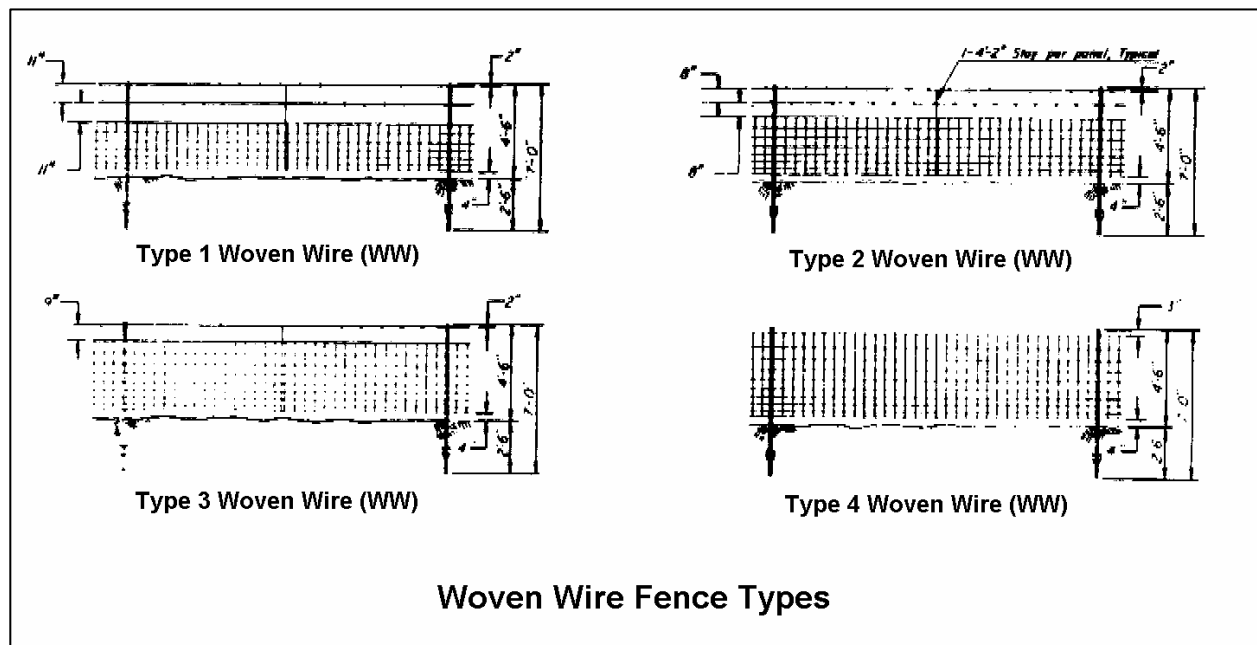


Materials for chain-link cable barriers must be accompanied by a Certificate of Compliance. A cable-link cable barrier is used to block pedestrian and vehicular traffic on a median strip.

The type of wire fence to be used on a project will be specified in the project plans. It can be barbed wire, as well as game and antelope fence, both of which use barbed wire in their construction. Each of these three types of wire fence can be either Type 1 or Type 2. Type 1 wire fences have four strands of barbed wire; Type 2 wire fences have five strands of barbed wire. The basic differences within Type 1 or Type 2 categories of wire fence are the spacing of the individual strands and the length of the stays.



A wire fence also may be a woven wire fence. This fence is constructed in four different types. The main differences among these types are the height of the woven wire fabric and that Types 1, 2, and 3 are topped with barbed wire, whereas Type 4 is not.



Keep in mind that wire fences and gates must meet the established construction specifications, which we will look at more closely.

Cattle guards are used instead of gates as specified in the project plans.

## Setting Fence Posts

When constructing chain-link fence or chain-link cable barriers, place the posts at ten-foot intervals which have been measured parallel to the ground. Place intermediate post assemblies at 500-foot intervals or midway between pull-post assemblies which are placed 500 to 1,000 feet apart.

Set the posts vertically or perpendicular to the ground. They must be set in concrete which must cure at least 72 hours before wire or fence fabric is attached.

Corner fence posts for chain-link fences are required if there is:

1. a vertical deflection in the fence alignment of 10 degrees or more, or
2. a horizontal deflection in the fence alignment of 30 degrees or more.

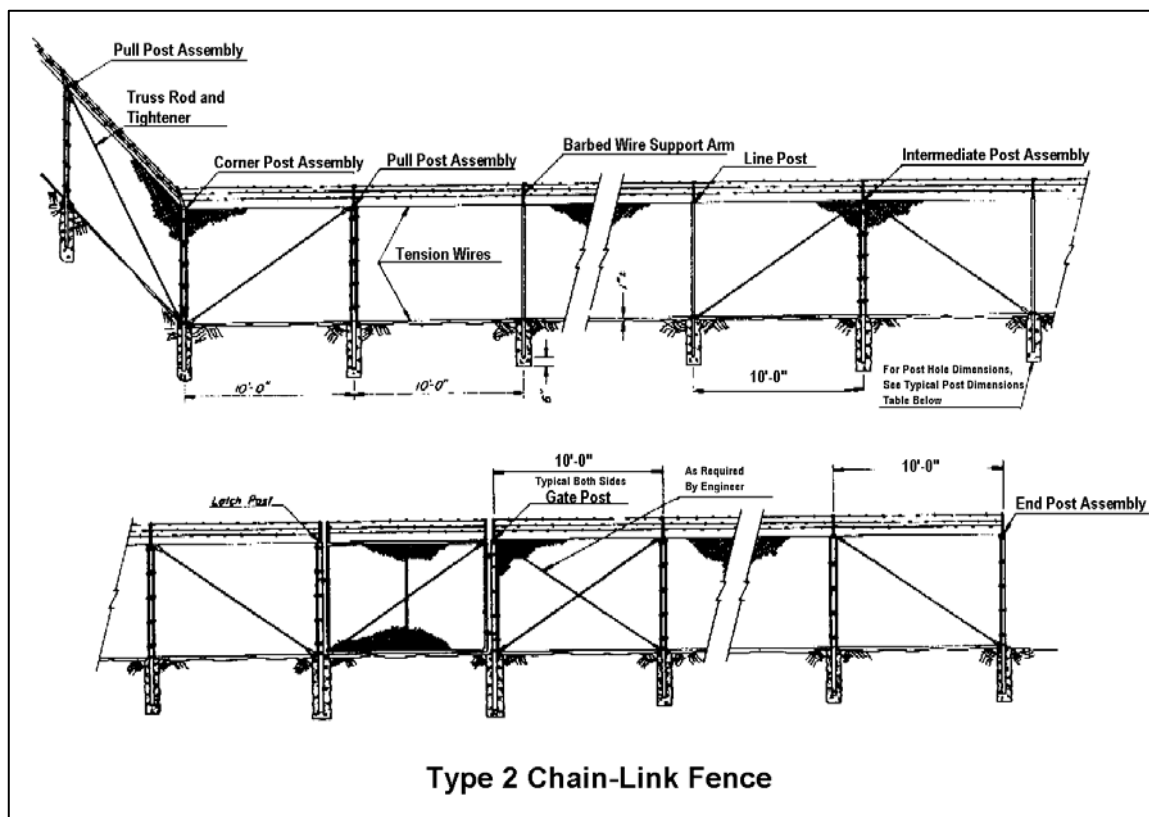
When building wire fences, you must use posts which are seven feet long and painted green. The same type of posts must be used throughout any project. To set the posts, drive them vertically or perpendicularly to the ground and be sure to backfill any voids. Set all end, corner, pull, latch, and gate posts in crowned concrete footings which are sloped away from the posts for water to drain properly.

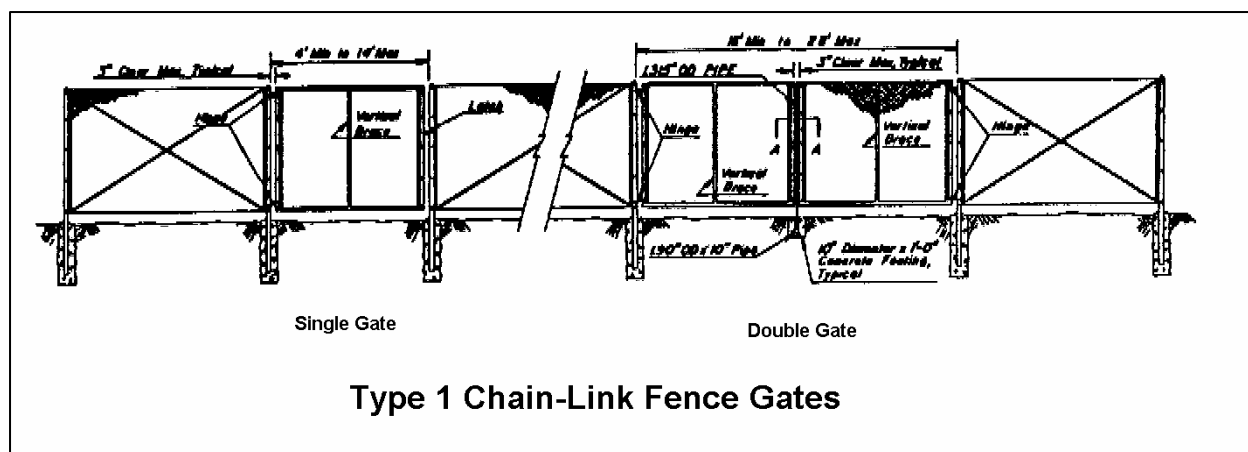
Intermediate post assemblies must be installed at no more than 650-foot intervals between braced posts or when installing **woven wire fence**, as often as necessary to reduce cutting and waste. Place corner post assemblies wherever the horizontal deflection of the fence alignment is 15 degrees or more. If the deflection is between 5 and 15 degrees, diagonal tension wires must be installed.

## Installing Chain-Link Fences and Gates

To install chain-link fabric, it must be fastened to the outside of set fence posts unless otherwise specified. Fasten the top and bottom of the fabric to taut, horizontal tension wires. The top wire must be more than two inches from the top of the fabric. When attaching the chain-link fabric, use:

- stretcher bars and stretcher bar bands to fasten it to end, corner, latch, gate, and pull posts. Space stretcher bar bands no more than fourteen inches apart;
- wires or post clips, spaced every fourteen inches, to attach the fabric to line posts; and
- wires or hog rings, placed every 18 inches, to fasten the fabric to the top and bottom tension wires.





Chain-link fence gates must be made of the same fabric as the adjacent fence. Fasten the chain-link fabric to the gate frames using stretcher bar bands, and tie wires. The gates must be hung on at least two malleable iron hinges which are at least three inches wide. Also, the gates must have a steel or iron catch which cannot rotate around the latch posts.

The gate frames themselves must:

- be constructed of 1-1/2-inch zinc-coated pipe,
- be welded at corners, and
- have a vertical member made of one-inch zinc-coated pipe if the gate is wider than eight feet.

## Installing Wire Fences and Gates

When installing barbed, barbedless, and woven wire, cut and fasten it to each post so it is taut. Use intermediate posts as necessary to maintain proper clearances between the bottom wire and the ground surface. Place vertical wire stays, which must be woven into the horizontal strands, to maintain the proper spacing between the wire strands as required by the project plans. If posts are placed in grade depressions where tension on the wires may pull them from the ground, set the posts in concrete or weight the fence wires with sag weights which weigh at least 100 pounds each.

When installing barbed wire, there can be more than two splices between any two braced post assemblies and they cannot be on the same wire. These splices must be at least 100 feet from the nearest braced post assembly.

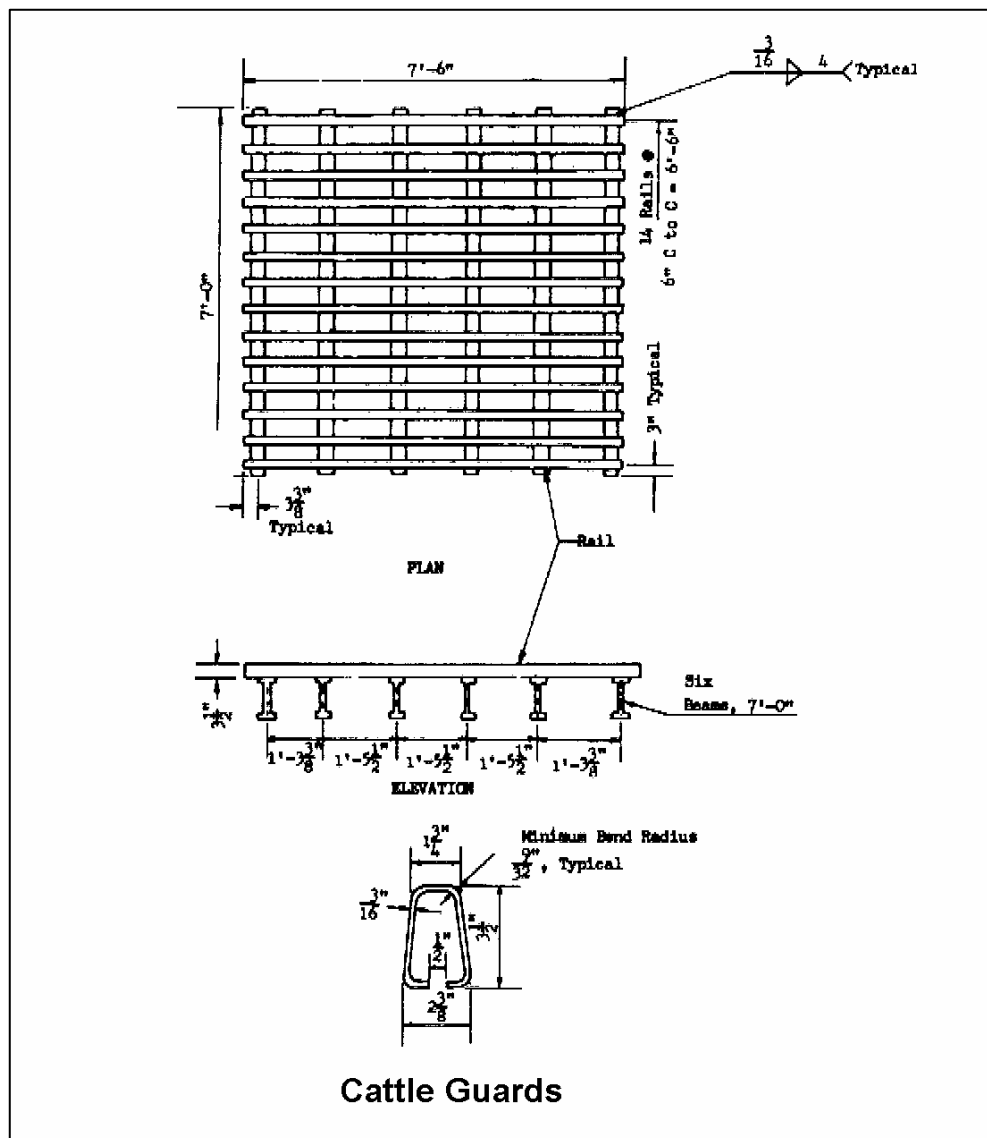
If installing barbed-wire or game fence, the distance between the bottom wire and the ground may vary up to four inches from specifications found in the project plans. When installing woven wire fence, this distance can vary only one inch from the project plans.

Gates for Type 1 wire fences must be made of chain-link or woven-wire fabric. For a barbed-wire fence, use Type 2 woven-wire fabric for the gate. If the gate is wider than five feet, it must have a vertical member. Each gate must have at least two malleable iron or steel hinges and also must have an iron or steel catch that cannot rotate around the latch post.

When constructing gates for Type 2 wire fences, each wire must be securely fastened to the gate post and latch board. Each gate must have three equally spaced wire stays. An upper and lower wire must be placed on the latch post to receive the latch board. There must be a pry stick to keep the fence taut. The latch board may be a 2" x 2" x 4' piece of Douglas fir; the pry stick may be a 2" x 2" x 2' piece of Douglas fir or made of the same steel used for the line posts. Flood gates must be constructed at locations specified in the project plans or wherever determined by the Engineer. The Engineer will also determine the need and placement of line posts. Construct them in the same manner as for barbed-wire fence construction, except sag weights which must weigh 35 pounds each.

## Installing Cattle Guards

Whether cattle guards to be installed are cast-in-place or precast as determined by the Engineer, they all must drain well. If existing cattle guards are to be reconstructed for reuse, do not damage their parts while they are being dismantled.



## Section One Quiz

1. What is the most obvious difference between Type 1 and Type 2 chain-link fence? (Circle one)
  - a. Type 1 is zinc-coated steel; Type 2 is aluminum-coated steel.
  - b. Type 1 is aluminum-coated steel; Type 2 is zinc-coated steel.
  - c. Type 1 has barbed wire stretched above the chain-link fabric; Type 2 does not.
  - d. Type 2 has barbed wire stretched above the chain-link fabric; Type 1 does not.
2. When constructing a chain-link fence for a specific construction project ... (Circle one)
  - a. zinc-coated fence components can be used interchangeably with aluminum-coated components.
  - b. zinc-coated and aluminum-coated components cannot be used interchangeably.
3. The basic difference between Type 1 and 2 barbed-wire fence is ... (Circle one)
  - a. Type 1 has four strands of wire; Type 2 has five strands.
  - b. Type 1 has five strands of wire; Type 2 has four strands.
  - c. Type 1 has more barbs per yard of fence.
  - d. Type 2 has more barbs per yard of fence.
4. When building a chain-link fence, corner fence posts are required ... (Circle one or more)
  - a. where the vertical deflection in the fence alignment is 10 degrees or more.
  - b. where the vertical deflection in the fence alignment is 30 degrees or more.
  - c. where the horizontal deflection in the fence alignment is 10 degrees or more.
  - d. where the horizontal deflection in the fence alignment is 30 degrees or more.
5. When building wire fences, which posts must be set in concrete? (Circle one or more)
  - a. all line posts
  - b. gate posts
  - c. end posts
  - d. latch posts
6. Gate frames for chain link fences must be ... (Circle one or more)
  - a. welded at corners.
  - b. no longer than eight feet.
  - c. constructed of 1-½-inch zinc-coated pipe.

7. When posts must be placed in areas where tension on the wire may pull them out ... (Circle one or more)
- a. they must be properly braced.
  - b. place sag weights on the fence wires.
  - c. set the posts in concrete.
8. The splicing requirements for installing barbed wire fences include ... (Circle one or more)
- a. no more than four splices between any two posts.
  - b. no more than two splices between any two posts, but not on the same wire.
  - c. no more than one splice on any wire between any two braced post assemblies.
  - d. splices must be at least 100 feet from nearest braced post assembly.
9. Gates for Type 1 wire fences must be made of ... (Circle one or more)
- a. barbed wire.
  - b. chain-link fabric.
  - c. woven-wire fabric.
10. What material can be used for a latch board in a Type 2 wire fence? (Circle one or more)
- a. zinc-coated steel
  - b. aluminum-coated steel
  - c. same steel used for line posts
  - d. Douglas fir

## Section One Quiz Answers

1. d. Type 2 has barbed wire stretched above the chain-link fabric; Type 1 does not.
2. b. zinc-coated and aluminum-coated components cannot be used interchangeably.
3. a. Type 1 has four strands of wire; Type 2 has five strands.
4. a. where the vertical deflection in the fence alignment is 10 degrees or more.  
b. where the horizontal deflection in the fence alignment is 30 degrees or more.
5. b. gate posts  
c. end posts  
d. latch posts
6. a. welded at corners.  
c. constructed of 1-1/2-inch zinc-coated pipe.
7. b. place sag weights on the fence wires.  
c. set the posts in concrete.
8. b. no more than two splices between any two posts, but not on the same wire.  
c. no more than one splice on any wire between any two braced post assemblies.  
d. splices must be at least 100 feet from nearest braced post assembly.
9. b. chain-link fabric.  
c. woven-wire fabric.
10. c. same steel used for line posts  
d. Douglas fir



## **Section Two: Guardrails**

### **Guardrail Materials**

When constructing guardrails, either steel posts and steel blocks or wood posts and wood blocks must be used. Any fresh wood cuts made on site must be swabbed with two coats of the same preservative previously used on the cut wood.

All rail element surfaces exposed to traffic must be free of scars, stains or corrosion. The design of these elements must meet various American Road and Transportation Builders Association (ARTBA) specifications. Because it would be impractical to cover these specifications here, refer to Table 1012-2 in the *Standard Specifications for Road and Bridge Construction* for further information on them.

Fasteners used to connect rail elements to the posts also must meet various American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and American Association of State Highway and Transportation Officials (AASHTO) standards. For further information on them, refer to Table 1012-1 in the *Standard Specifications for Road and Bridge Construction*.

In addition, there are certain requirements for miscellaneous guardrail materials:

- use sixteen-penny common galvanized nails where nailing is necessary;
- concrete used for breakaway cable terminals and guardrail anchor assemblies must meet Class S concrete specifications;
- polystyrene filler for breakaway cable terminals and guardrail anchor assemblies must be one-half inch thick; and
- reflectors must be faced with high-reflectivity, silver-white or yellow sheeting.

### **Setting Guardrail Posts**

Wood and steel guardrail posts may be placed by:

- driving them,
- digging their holes by hand, or
- excavating their holes mechanically.

Be careful not to damage posts when driving them. If you are driving wood posts, prepunched holes may be required. Posts may not be driven if they will damage existing features such as curbs, gutters, sidewalks, buried items, shoulders, pavement, or utilities.

When setting guardrail posts in concrete, place the concrete against undisturbed, excavated earth. Be sure to place the polystyrene filler around the post; do not nail or staple it. Keep in mind if six-inch by eight-inch rectangular wooden posts are being used, the eight-inch dimension must be perpendicular to the rail. Unless using concrete to set the posts, use approved backfill material; place it and compact it in layers.

Reflectorized tabs must be placed at a maximum interval of 37 feet, 6 inches unless otherwise specified in the project plans. Place the silver-white tabs on the right-hand side of the roadway and place the yellow tabs on the left-hand side of one-way roadways and ramps.

## **Installing Guardrail Elements**

All metal work prefabrication must be completed in the shop, not on site. When placing guardrail elements, follow these splicing guidelines:

- lap guardrail elements in the direction of traffic in the nearest adjacent lane; and
- splice these elements at twenty-five foot intervals or less except where breakaway terminals are being constructed.

In this case, splice no closer than 12 feet-6 inches to the terminal posts.

- splice at guardrail posts unless otherwise shown on the plans and install back-up plates on steel posts where splices do not occur;
- the guardrail must have full bearing capacity at all joints; and
- if the radius of the guardrail curvature is 150 feet or less, the elements must be curved in the shop.

## **Elements**

All breakaway cable terminals and anchor assemblies must be installed in accordance with the project plans. Follow these guidelines when pouring concrete footings for these terminals and assemblies:

- place concrete against undisturbed excavations,
- make them flush to the ground line,
- trowel them to a smooth finish, and
- slope them to drain away from the posts.

After placing these footings, cover them with four inches of loosened, moistened earth or cover them with an approved liquid-membrane curing compound.

Buried guardrail anchors must be constructed with two W-beam elements belted to a buried portion of guardrail posts and they must be buried in a trench according to the project plans. If the anchors are coated with bituminous material, this coating must meet AASHTO M-190 requirements. Any backfill which is used must be approved.

Bolted guardrail anchors must be constructed with two steel brackets bolted to a shortened post and to the roof of a box culvert as shown in the project plans. If the top of a culvert or another feature blocks the placement of a post having a specified length, shorten the post and anchor it in accordance with the project plans.

Any transition to concrete barriers must be constructed according to project plans.

## Section Two Quiz

1. Concrete used for rail anchor assemblies must meet specifications for which class of concrete? (Circle one)
  - a. Class B
  - b. Class P
  - c. Class S
  - d. Utility
2. Wood and steel guardrail posts may be placed by... (Circle one or more)
  - a. driving them.
  - b. prepunching their holes.
  - c. digging their holes.
  - d. mechanically excavating their holes.
3. Silver-white reflectorized tabs must be placed on guardrail tabs which are on the \_\_\_\_\_ side of the roadway ... (Circle one)
  - a. left
  - b. right
4. Which of the following are splicing requirements for guardrail elements? (Circle one or more)
  - a. splice at guardrail posts unless otherwise shown on the plans.
  - b. all joints must have full bearing capacity.
  - c. install back-up plates on steel posts where splices do occur.
  - d. lap guardrail elements in the direction of traffic.
5. Footings for anchor assemblies are cured by covering them with ... (Circle one or more)
  - a. polyethylene film for 72 hours.
  - b. four inches of loose soil.
  - c. an approved liquid membrane.
  - d. curing compound.
6. If a culvert interferes with the placement of a guardrail ... (Circle one or more)
  - a. move the post to an approved location.
  - b. shorten the post.
  - c. anchor it according to the project plans.
7. Shop-curved radius rail shall be used when ... (Circle one)
  - a. the radius of curvature is 150 feet or less.
  - b. the radius of curvature is 150 feet or more.
  - c. at the contractor's discretion.

## Section Two Quiz Answers

1. c. Class S
2. a. driving them.  
c. digging their holes.  
d. mechanically excavating their holes.
3. b. right
4. a. splice at guardrail posts unless otherwise shown on the plans  
b. all joints must have full bearing capacity  
d. lap guardrail elements in the direction of traffic
5. b. four inches of loose soil.  
c. an approved liquid membrane curing compound.
6. b. shorten the post.  
c. anchor it according to the project plans.
7. a. when radius of curvature is 150 feet or less.

## Section Three: Bank Protection

### Types

All types of bank protection must be constructed according to the project plans. These types, all found in Section 913, include:

- Dumped Riprap
- Wire-tied Riprap
- Grouted Riprap
- Slope Mattress Riprap
- Gabions
- Sacked Concrete Riprap

All rock used in the construction of bank protection must be:

- sound;
- durable; and
- free from clay, shale seams, cracks, and other structural defects.

If the rock is to be used for dumped riprap, it must have an angular shape. If the rock is used for other types of bank protection construction, it may have a rounded shape and be made up of stones or boulders.

The bulk specific gravity (SSD) of the rock shall be a minimum of 2.4 when determined in accordance with AASHTO T-85. Rock shall have a least-dimension not less than one-third of its greatest dimension and a gradation meeting the requirements specified for the type of bank protection. Control of the gradation will be by usual inspection.

The metal items used in bank protection construction, including welded-wire fabric, woven-wire fabric, fittings, hardware, tie wire, steel cable, railroad rail, and soil anchor stakes must be approved and meet respective AASHTO and ASTM regulations. For further information regarding these regulations, refer to Section 913-2.02(A)-(F) in the *Standard Specifications for Road and Bridge Construction*.

Bedding must be made up of granular material no larger than two inches in its largest dimension. This material must be free from clay and organic material.

Grout used in bank protection construction shall consist of one part portland cement, three parts fine aggregate and one-fifth hydrated lime by volume. Do not use grout which has been mixed more than one hour.

Filter fabric must conform to the requirements of Subsections 1014-1 and 1014-5 of the ADOT *Standard Specifications*.

If using sacked concrete for bank protection construction, the minimum acceptable cement content is 376 pounds per square yard. It also must have a slump of three to five inches.

## **General Construction Requirements**

The area where bank protection is to be built must be cleared, grubbed, and excavated or backfilled to produce a surface which conforms to the lines and grades established in the project plans. The under water placement of any bank protection features is prohibited unless approved by the Engineer.

Before placing any filter fabric on the ground, the ground surface must be free of obstructions, depressions and debris. Place the filter fabric loosely; do not stretch it tightly. Overlap the joints at least twenty-four inches. Filter fabric strips placed uphill must overlap downhill strips; upstream filter fabric strips must overlap downstream strips. If rock greater than eighteen inches in size is to be placed over the fabric, first place a four-inch layer bedding material on the fabric before placing the rock. Be careful not to damage the fabric when placing the rock.

### **Dumped Riprap**

Place the rock to a specified thickness in one operation. The rocks must be placed so that there is a minimum amount of voids. No segregation of material is allowed. Hand placing or mechanical rearranging of rocks may be necessary to make the layer even and to reduce the voids.

### **Wire-Tied Riprap**

Place the lower layer of wire mesh first, then place the rock in the same way as for dumped riprap. After placing the rock, place the upper layer of wire over the rock, then lace it and tie it according to the project plans.

### **Grouted Riprap**

Place the rock in the same manner as for dumped riprap, then moisten the stones thoroughly. Sluice the excess fines to the underside of the stone blanket before placing the grout. Deposit the grout uniformly to prevent any segregation of materials. The grout must penetrate to the depth specified in the plans. Do not place the grout if the ascending temperature has not yet reached 35° F or if the descending temperatures falls below 40° F. Curing of the grout shall be accomplished by keeping it continually moist for 7 days after placement, by liquid membrane curing compound or by use of polyethylene sheeting.

## **Slope Mattress Riprap**

Excavate the mattress bed to the width, line and grade as shown on the plans. Be sure the excavation for toe or cut-off walls are made to the neat lines of the walls. Assemble the sides, ends, lids, and diaphragms of the slope mattress into rectangular units at the job site. All edges must be securely selvedged or bound so the joints are as strong as the mesh. Before filling the slope mattress, tie the adjoining units with wire ties or spiral ties and anchor the units according to the project plans. Place the stone in at least two layers to obtain the maximum fill in the slope mattress. At the Engineer's discretion, broken concrete may be placed in the bottom of the slope mattress instead of stone.

## **Gabions**

As with the slope mattress bed, excavate the gabion bed to the width, line, and grade as shown on the plans. Make the excavation for the toe or cut-off walls to neat lines of the walls. Perform assembly of the sides, ends, lids, and diaphragms at the job site. When constructing the gabions, the length of the cells shall not exceed their width. As necessary, use the diaphragms to divide the cells into acceptable sizes. The edges of the cells must be securely selvedged or bound. Fill each cell with rock placed in three different lifts. Place the rock carefully so not to damage the wire mesh. Tie two connecting tie wires between each lift. The last lift must be even with the top of the cell.

Tie all filled units together, then place empty gabions on top of the filled ones and tie them on their fronts, sides and backs. Secure all contacting sides to neighboring gabions.

## **Sacked Concrete Riprap**

When constructing sacked concrete riprap as bank protection, each sack should be filled with one cubic foot of concrete. Place the sacks according to the project plans. Trample them lightly to make them conform to each other and to the earth.

Place the sacks in at least three courses:

- First foundation course – place a double row of stretchers in a neat trench. Be sure all dirt and debris is removed from the tops of the sacks before adding subsequent layers.
- Second foundation course – place a double row of stretchers directly above the double row of stretchers in the first course.
- Third course and subsequent courses – place stretchers so staggered joints are formed.

If anything such as storms or mud causes a delay in placing succeeding sacks which will result in the improper bearing or bonding of the concrete, excavate a small trench behind the rows already in place. This trench must be filled with approved concrete before placing additional courses, Cure sacked riprap by covering it with a blanket of wet earth or spray it lightly with water every two hours during the daytime for four days.



## **Rail Bank Protection**

Excavate for the rock fill as necessary and place the rails at the locations and to the depths as required by the project plans. The Engineer may order jetting or drilling to get the minimum depth necessary for placement of the rails. After the rails have been placed, securely wire the fabric to the rails, then place it in the trenches and on the slopes. While placing the rock backfill, do not damage the fabric. The wire fabric must completely enclose the rock backfill. Backfill the rock fill and remove debris as necessary.

## Section Three Quiz

1. Rock used for dumped riprap must ... (Circle one)
  - a. have a rounded shape.
  - b. have an angular shape.
  - c. be 2 inches in its largest dimension.
2. Do **not** use grout which ... (Circle one)
  - a. is one part portland cement.
  - b. is three parts fine aggregate.
  - c. is one-fifth hydrated lime by volume.
  - d. has set for 1-2 hours.
3. When constructing bank protection, place the filter fabric ... (Circle one or more)
  - a. loosely.
  - b. so it is stretched.
  - c. so the joints overlap 24 inches.
  - d. on a ground surface free from obstructions.
4. When constructing wire-tied riprap, place the rock in ... (Circle one)
  - a. one layer.
  - b. two layers.
  - c. three layers.
5. When constructing grouted riprap, the grout must be .... (Circle one)
  - a. 18 inches deep.
  - b. 24 inches deep.
  - c. as deep as specified.
6. The sides and diaphragms used in a slope mattress riprap must be assembled ... (Circle one)
  - a. at the shop.
  - b. on the job site.
7. When constructing slope mattress riprap, place the rock in ... (Circle one)
  - a. one layer.
  - b. two layers.
  - c. three layers.

8. When constructing gabions, ... (Circle one or more)
- a. use diaphragms to divide the cells into acceptable sizes.
  - b. fill the cells with two lifts of rock.
  - c. make the last lift even with the top of the cell.
  - d. secure the empty gabions to all contacting sides of neighboring gabions.
9. When constructing the second foundation course of a sacked concrete riprap, place ... (Circle one)
- a. a double row of stretchers directly above headers in the first course.
  - b. a double row of headers directly above the stretchers in the first course.
  - c. a double row of stretchers so they are staggered above the headers in the first course.
  - d. a double row of headers so they are staggered above the stretchers in the first course.
10. Cure sacked riprap by... (Circle one or more)
- a. covering it with polyethylene film for 72 hours.
  - b. covering it with wet earth.
  - c. spraying it lightly with water every two hours during daytime for four days.

## Section Three Quiz Answers

1. b. have an angular shape.
2. d. has set for 1-2 hours.
3. a. loosely.  
c. so the joints overlap 24 inches.  
d. on the ground surface free from obstructions.
4. a. one layer.
5. c. as deep as specified.
6. b. on the job site.
7. b. two layers.
8. a. use diaphragms to divide the cells into acceptable sizes make.  
c. the last lift even with the top of the cell.  
d. secure the empty gabions to all contacting sides of neighboring gabions.
9. b. place a double row of headers directly above the stretchers in the first course.
10. b. covering it with wet earth.  
c. spraying it lightly with water for four days.

## **Section Four: Landscaping**

### **Sections 801-808**

Landscaping is one of the last steps in many highway construction projects. It not only adds to the general appearance of the roadway, but also helps control erosion. Landscaping includes:

- such preparations as excavating and grading the roadside, providing borrow material and topsoil, and installing irrigation systems; Section 801, 802, 803, 804;
- seeding and mulching; Section 805;
- planting trees, shrubs and other plants; and Section 806; and
- caring for the landscaped features to be sure that they are adequately established, Section 807 and 808.

### **Preparations for Landscaping**

#### **Landscaping Excavation and Grading**

As landscaping excavation and grading operations are undertaken, see that:

- the ground is cut, filled, and shaped to the lines, grades, and cross-sections specified in the plans;
- any surplus material is properly hauled to an approved disposal site;
- areas outside designated planting beds and lawns are shaped to smooth surfaces; and
- final surfaces are raked to remove trash, weeds, stone greater than two inches in diameter, and any other objectionable material.

#### **Landscape Borrow**

Sometimes, the existing material may not be fully adequate for the landscaping. In such situations, the contractor must furnish, haul, and place imported material. These imported materials can consist of many different materials such as soil backfill and planting material, decomposed granite, granite mulch and rock mulch. All types have different requirements and applications as shown on the plans. See that:

- the area is cleared of objectionable material before any borrow is placed;
- the borrow material is from an approved source;
- the borrow material is placed to the required lines and grades; and
- the material is watered and compacted as required by the special provisions.

## **Topsoil**

In addition, the contractor may also be required to provide, haul, and place topsoil. The topsoil must:

- be either from a designated source, or accompanied by a soil analysis that indicates the pH, total soluble salts, plasticity index and gradation;
- be fertile, friable, free-draining and capable of supporting healthy plant growth;
- be reasonably free of such deleterious substances as calcium carbonates, trash, heavy clay, noxious weeds, large rocks, sticks, and brush;
- meet certain pH, soluble salts, plasticity index, and gradation requirements; and
- be covered by a Certificate of Analysis.

As topsoil is placed, see that:

- it is spread uniformly over the designated areas to the required depth; and
- the finished surface is free of any rocks larger than one inch in diameter.

## **Irrigation Systems**

When irrigation or other water distribution systems are required, they must be furnished and installed in accordance with the Special Provisions and *Standard Specifications*, Section 808.

## **Seeding**

Where seeding is required, the contractor must prepare the soil and provide and apply seeds, mulch, and other materials.

Seeding materials must be covered by Certificates of Compliance and include:

- the specified species, strain or origin of seed provided in sealed, undamaged, and properly labeled containers;
- the specified type of mulch, including manure, peat humus, wood cellulose fibers, or straw;
- water from an approved source; and
- tacking agent and chemical fertilizer as specified in the Special Provisions.

All seeding must be carried out in accordance with the Special Provisions in terms of the types of seeds, specified planting seasons, preparation of the soil and application rate.

Lawn seeding is designated as Class I seeding. For Class I seeding, see that:

- any required topsoil is placed at least one week in advance and watered at least twice prior to seeding;
- the surface is raked or loosened immediately before seeding;

- the seed is uniformly placed in two applications at right angles to each other; and for mulching, manure is uniformly applied (at one cubic yard per 1000 square feet) and the area is watered immediately after seeding.

Hydroseeding may be used as an alternative Class I seeding method, but it also must meet certain specific requirements.

Class II seeding includes the seed for range grass, flowers or shrubs with mulching. See that:

- the surface is broken up to the specified depth;
- the seed is drilled, broadcast, or otherwise planted at the specified rate;
- the specified type of mulch is applied using the required method and rate of application; and
- any required tacking agent is properly applied with adequate measures taken to protect structures and vehicles from stains.

Class III seeding also includes seeds for range grass, flowers and shrubs but without mulching. Class III seeding must otherwise meet the same basic requirements as for Class II seeding.

The contractor is responsible for preserving all seeded areas and regrading, reseeding, and remulching any damaged areas.

## **Trees Plants and Shrubs**

The materials used in planting trees, shrubs, and other plants include:

- the plants themselves as either:
  - nursery stock,
  - collected stock (from outside the project limits), or
  - local stock (from within the project limits);
- topsoil and/or prepared soil (a uniform mixture of topsoil, humus, fertilizer, and other additives per the Special Provisions);
- mulch, water and fertilizer; and
- such miscellaneous materials as stakes and hardware.

## **Preparations for Planting**

Before planting, see that:

- all Certificates of Compliance for all contractor-furnished materials are submitted;
- the planting is to be done during the season or time specified in the Special Provisions;
- plant locations are laid out and staked at the correct plan locations;
- planting pits, trenches, and beds are excavated to established lines and grades; and
- all surplus, excavated material is disposed of at an approved location.

The plant stock must be properly shipped and handled, including:

- proper balling and burlapping of the trees and shrubs;
- protection from sun, wind, or freezing temperatures; and
- planting within 24 hours after delivery or protecting the root system until planting.

## **Planting**

Make sure the soil is not too moist immediately before planting is to begin. If irrigation systems also are required, they must be installed, tested and in proper operating condition before the planting takes place. During the planting:

- reject any plants which have broken root balls after they are removed from their containers;
- do not compact backfill around the roots or the ball of the plant;
- plumb and center the plants in their planting pits or trenches;
- set the plants at the grade established in the project plans (if any plants are set at an incorrect grade, they must be reset); and
- saturate the surrounding backfill surrounding the plants' root systems immediately after the planting.

## **Pruning and Staking**

When pruning:

- it must be done in accordance with accepted horticultural practices, and
- treat pruning cuts larger than three-fourths of an inch with an approved tree wound dressing.

To stake the trees properly:

- add guying as necessary to hold the trees in place,
- place the tree stakes at least six inches into undisturbed ground beyond the trees' root systems, and
- adjust the tree ties and guy wires as necessary to insure proper growth and to prevent injury to trees.



## **Care and Protection**

The contractor is responsible for the protection of trees, shrubs, and plants for the number of calendar days specified in the Special Provisions until the landscape is established. These responsibilities include:

- watering;
- removing trash;
- controlling weeds;
- repairing, adjusting or replacing stakes;
- furnishing and applying sprays and dusts for disease and insect control; and
- providing weather protection.

The contractor is also responsible for removing and replacing dead plants as well as replacing injured plants, damaged plants and plants that will not grow as determined by the Engineer.

## Section Four Quiz

1. Topsoil used for landscaping must be ...(Circle one or more)
  - a. free-draining.
  - b. friable.
  - c. free from all rocks.
  - d. free from deleterious substances.
2. Class I seeding includes ... (Circle one)
  - a. lawn seed.
  - b. range grass.
  - c. flowers.
  - d. shrubs.
3. Topsoil for Class I seeding must be \_\_\_\_\_ before seeding operations begin. (Circle one)
  - a. dry
  - b. watered once
  - c. watered twice
4. Mulching is **not** included in \_\_\_\_\_ seeding. (Circle one)
  - a. Class I
  - b. Class II
  - c. Class III
5. How should the soil be just before planting trees? (Circle one)
  - a. dry
  - b. not too moist
  - c. very moist
  - d. saturated
6. When backfilling around the roots or ball of a shrub ... (Circle one)
  - a. place it and compact it in layers.
  - b. place it and compact in one layer.
  - c. place it but do not compact it.
7. Who is responsible for protecting the plants until the landscape has been established? (Circle one)
  - a. the Department
  - b. the Contractor
  - c. the Subcontractor
  - d. the Inspector

## Section Four Quiz Answers

1.   a. free-draining.  
     b. friable.  
     c. free from deleterious substances.
2.   a. lawn seed.
3.   c. watered twice
4.   c. Class III
5.   b. not too moist
6.   c. place it but do not compact it.
7.   b. the Contractor